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# मानक

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IS 11123 (1984): Method for determination of copper by atomic absorption spectrophotometry [CHD 1: Inorganic Chemicals]



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“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*

METHOD FOR DETERMINATION OF  
COPPER BY ATOMIC ABSORPTION  
SPECTROPHOTOMETRY

UDC 543.422 : 546.56



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**INDIAN STANDARDS INSTITUTION**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard*

# METHOD FOR DETERMINATION OF COPPER BY ATOMIC ABSORPTION SPECTROPHOTOMETRY

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## *Indian Standard*

# METHOD FOR DETERMINATION OF COPPER BY ATOMIC ABSORPTION SPECTROPHOTOMETRY

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 31 July 1984, after the draft finalized by the Chemical Standards Sectional Committee had been approved by the Chemical Division Council.

**0.2** The atomic absorption spectrophotometric method is dependent on the fact that atoms, in the ground state, will absorb light of the same wavelength they emit when excited. When radiation from given excited atoms is passed through a flame containing atom in the ground state, the intensity of the transmitted radiation will decrease in proportion to the amount of the ground state atoms in the flame. A hollow cathode lamp whose cathode is made of the element to be determined or a suitable electrodeless discharge lamp provides the radiation. The atoms of the elements to be measured are placed in the beam of radiation by aspirating the specimen into an oxidant fuel flame. The absorbance is taken as a measure of concentration of the analysed atom.

**0.3** Various products where copper estimation may be required include alloys, high purity metals, edible oils, wort, beer, yeast, rubber chemicals, rubber products, water samples, petroleum products, soils, catalysts, etc.

**0.4** In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960\*.

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### 1. SCOPE

**1.1** This standard prescribes the atomic absorption spectrophotometric method for the determination of copper.

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\*Rules for rounding off numerical values ( *revised* ).

## 2. QUALITY OF REAGENTS

**2.1** Unless specified otherwise, pure chemicals and distilled water ( see IS : 1070-1977\* ) shall be used in tests.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of analysis.

## 3. OUTLINE OF THE METHOD

**3.1** The sample is dissolved in hydrochloric acid and oxidized with concentrated nitric acid and then evaporated to dryness; dissolved again in nitric acid ( 1 : 1 ) by boiling, allowed to settle and filtered; suitable dilutions are made to aspirate into air acetylene flame, making standards in the same way. The most sensitive copper absorption line is 324.8 nm; however, other lines suitable for higher concentrations can also be used.

## 4. INTERFERENCE

**4.1** No interferences have been reported for copper in the air acetylene flame but some depression has been noted at high Zn/Cu ratios. This can be minimised by a lean air acetylene flame or nitrous oxide acetylene flame.

## 5. APPARATUS

**5.1 Atomic Absorption Spectrophotometer** — generally with following parameters:

- a) *Suitable Lamp Current* — depending on the lamp and instrument used.
- b) *Support* — Air.
- c) *Fuel* — Acetylene.
- d) *Flame stoichiometry* — Oxidising.
- e) *Wavelength and working range*

<i>Wavelength</i> Rm	<i>Band pass/Slit</i> nm	<i>Working range</i> µg/l	<i>Remarks</i>
324.8	0.2	2-8	Set the wave length for the maximum energy within the marked portion
218.2	0.2	10-80	

NOTE — Rotate the burner position to accommodate high concentration of copper in the solution.

\*Specification for water for general laboratory use ( *second revision* ).



## 6. REAGENTS

**6.1 Copper Metal** — purity 99.99 percent.

**6.2 Concentrated Nitric Acid** — See IS : 264-1976\*.

**6.3 Concentrated Hydrochloric Acid** — See IS : 265-1976†.

**6.4 Standard Copper Solution** — Dissolve 0.100 g of copper metal in a minimum volume of 1 : 1 nitric acid and dilute to one litre to give 100 µg/ml of Cu. Make appropriate dilutions from the stock solution.

## 7. PROCEDURE

**7.1** Transfer appropriate quantity of the sample in a 400-ml beaker and add 50 ml of concentrated hydrochloric acid. Heat to dissolve, oxidise by dropwise addition of concentrated nitric acid. Evaporate to syrup and dissolve again in 40 ml of nitric acid (1 : 1) heat to boiling, add 100 ml water, boil again, cool and filter to remove silicious matter, make up to 250 ml with water, make appropriate dilutions.

**7.2** Optimise the response of the instrument by the adjustment of burner height and flame adjustment. Aspirate distilled water to get zero absorption. Aspirate blank and note down absorption, if any. Again aspirate distilled water to check zero. When stable response is observed, aspirate standards ( at least 4 ) and note down absorption.

**7.3** Aspirate sample to get absorption of the sample. Prepare calibration curve by plotting the net absorption value of the standards against concentration in mg/l of copper. Linear portion of the curve should be used for matching. Locate the point of sample absorption and calculate the concentration of copper in the sample. Alternatively, the concentration of copper is obtained direct from the instrument.

## 7.4 Calculation

$$\text{Copper, percent by mass} = \frac{C \times V}{10^6} \times \frac{100}{M}$$

where

$C$  = concentration of copper in µg/ml in final solution;

$V$  = volume in ml of final solution; and

$M$  = mass in g of the sample in final solution.

\*Specification for nitric acid ( *second revision* ).

†Specification for hydrochloric acid ( *second revision* ).

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS )

## Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>